



M. S. Perry.

Notes of

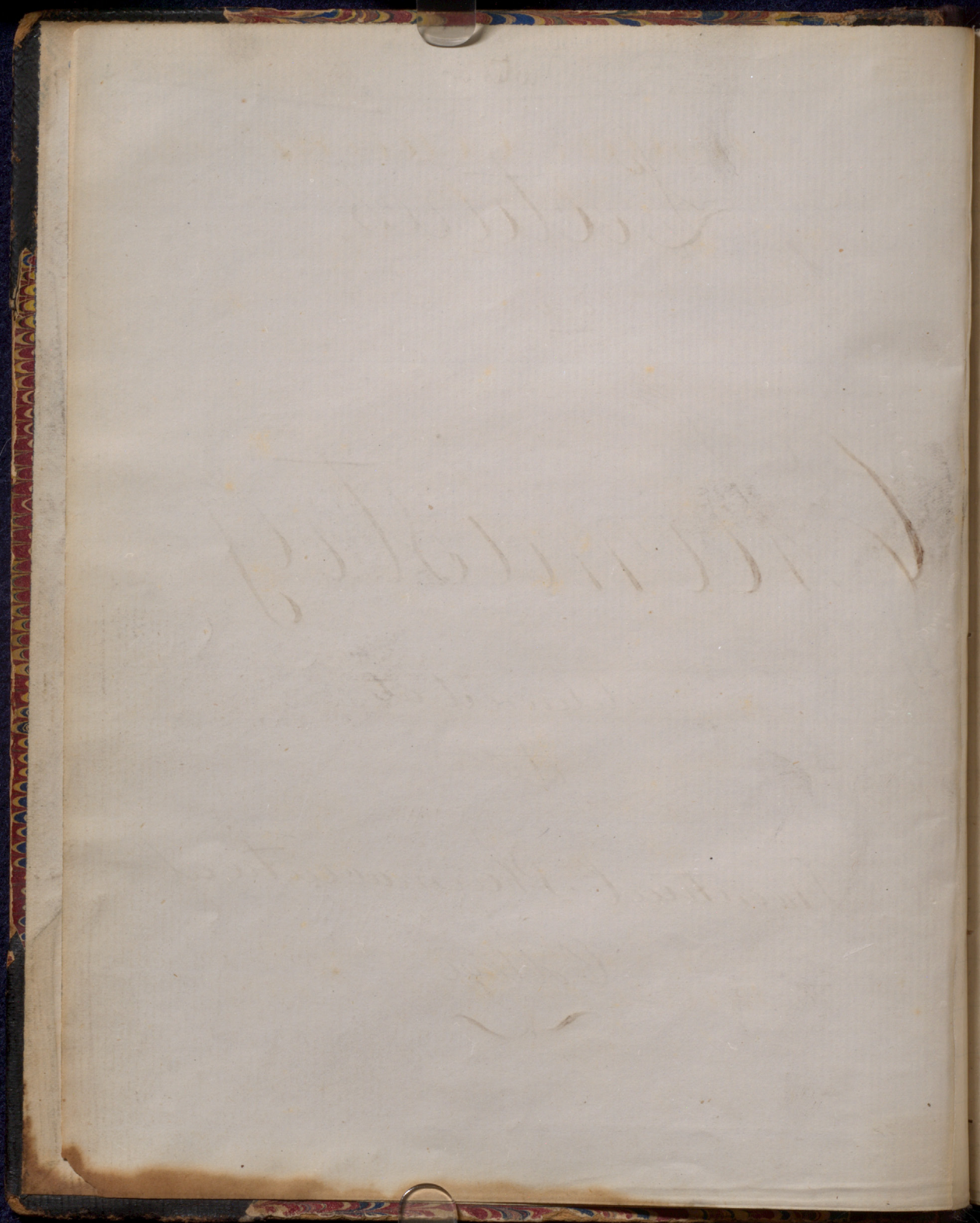
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Lectures
on

Chemistry

delivered at
the

Montreal Pharmaceutical
College



Tuesday October 2nd 1877
Lecture 1

All things are material
That which moves or alters them is
force

There are three masses

- 1st Simple all particles the same as Row
- 2nd Mixed A lump of different particles
compressed together
- 3rd Chemical; one in which the various
particles are so united that analysis
is necessary to divide them.

Atoms are the ultimate particles
of matter and are

Thursday Oct 4th 1877.
Lecture 2.

Affinity is the disposition between dif-
ferent bodies which causes them to

combine in definite quantities

Synthesis is a combination of two elements.

Analysis is the separation of combined bodies.

Combustion is chemical action combined & accompanied with light & heat. Organic substances when burnt show a surplusage of carbon. (SO_2)

Exp 1 Sugar ($\text{C}_6\text{H}_{12}\text{O}_6$) with Sulphuric Acid, added loses the water (H_2O) which joins the Acid leaving the carbon (C).

Exp 2 Sodium placed in water combines with the ~~water~~ oxygen in the water, hydrogen being freed.

Exp 3. The Decomposition of Zinc in water by Sulphuric Acid; setting free the hydrogen.

Tuesday Oct 9th 1877
 Lecture 3.

Elements are divided into two classes

Metallic and Nonmetallic

The nonmetallic produce nearly all the
non acid oxides as

Carbon + Oxygen ($C + O$) = Carbonic Oxide

" " " 2 parts ($C + O_2$) = " Anhydride

$H_2 + O_2 =$ Water (H_2O)

Composition 100 litres Air.

Oxygen 20.6

Nitrogen 77.9

Carbonic Dioxide $6 \frac{1}{4}$

Aqueous Vapour 1.4

Ammonia. Traces.

Thursday Oct 11th 1811
 Lecture 4.

Oxygen . O. . 16.

Discovered in 1774 by Priestley & Scheele

It is a colourless odourless & tasteless gas

And is a supporter of combustion having
 also a powerful affinity for other bodies
 Fluorine being the only element of which
 no oxide is known; nearly all bodies
 owe their acidity to it.

Its Specific Gravity is 1.105; 100 cubic
 inches weigh 34 Grains and a litre 1.435

It can be obtained from

Hydrarg. Ox. Rub by heating

Potass ~~Chlor~~ Chlor " "

Mangan Binoxide " " also from

Red lead: the Nitrates of Potass &

Soda: Bleaching powder: Also by

passing a current of air over the
 Hydrate of Barysta heated

A cheap manner of obtaining it in
 large quantities is by mixing

Chlorate of Potash & Peroxide of Mangan
are; but care must be taken that the
materials are pure because there is
danger of an explosion otherwise
Sulphur burnt in oxygen produces Sulphur
urous Acid (SO_2) Exp 4

Charcoal " " " Carbon
ic Acid in the form of Gas (CO_2) Exp 3

Exp 6 The presence of the Carbonic Acid
is produced by putting lime water in
the vessel in which combustion took
place; a white milky liquid is made

Metals Oils Leases and fine Powders
all undergo oxidization by exposure

Oxides are of three classes as

Gaseous Manganese Oxide

Neutral Water

Acid Phosphoric Acid

The more oxygen present the more acid
as $\text{CHO}_2 = \text{Formic Acid}$

$\text{C}_2\text{H}_2\text{O}_2 = \text{Acetic "}$

$\text{C}_5\text{H}_{10}\text{O}_5 = \text{Valerianic.}$

The Oxide of Nitrogen (NO) has the power also of supporting combustion.

Nitrate of Oxygen is more soluble in water than the gas.

To test a mixture. Pyrogallie Acid and Potash turn it black

Oxide of Nitrogen & Oxygen evolves red fumes

Tuesday Oct 16th 1877

Lecture 5

Combustion of Carbon in Oxygen in a closed vessel produces Carbonic Acid

Laws of Chemical Combination
Law 1. All Chemical are definite in their nature the ratios of their elements being constant

" II When a body is capable of combining with a second in ratios of proportion the proportions bear a simple relation

to each other

Law III If a body α unite with others B C, D. the quantities of the latter which unite with α , represent the relation in which they unite among themselves in case of a union taking place..

" IV The combining quality of a compound is the sum of the combining qualities of its elements.

Examples The Result of the combustion of two substances containing Carbon + Hydrogen produces water (H_2O) = 18
Carbon burnt in plenty of Oxygen =
(CO_2) Carbonic Acid; in little Carbonic
oxide (CO) ($CO = 28$) ($CO_2 = 44$)

Ex of IV Carbonic ~~Acid~~ ^{Acid} = 44

Oxide of Lime (CaO) = 56

$$\begin{cases} C = 12 \\ O = 32 \\ Ca = 40 \\ O = 16 \end{cases}$$

Soda Carb and Acid Hydrochloric
produce Carbonic Dioxide + leave
Chloride of Sodium

The result of combining Acid Muriatic
with Carbonate of Lead gives

5 Lect 16/10/77

similar results.

Carbonic Acid is produced from the lungs

CO_2 is capable of combining in two proportions.

Thursday Oct 18th 1877

Lecture 6th

Non Metallic Elements

Hydrogen H .1. is taken as the unit of the atomic weights as it is most capable of combining with the other elements in the smallest proportions

Hydrogen generally combines with Oxygen as H_2O (water) but sometimes H_2O_2 a peroxide of Hydrogen found in solution as ozone water.

Carbon (C, 12) is found in different forms resulting from the different decompositions of different substances. It is polymorphic, possessing three conditions 1st Graphite 2nd Crystalline 3rd Pulverulent.

It is largely obtained by roasting wood in closed vessels.

Charcoal burnt fully produces CO_2

Carbonic Dioxide leaving wood ashes from which potash is obtained

Plumbago and the Diamond are the results of imperfect combustion of substances containing Carbon.

Sort - another form of Carbon does not possess the power of destroying the colour of vegetable solutions as is possessed Animal Charcoal
Gum + Silicon these ~~possess~~^{possess} many

Qualities similar to Carbon viz they are all combustible in oxygen and polymorphic, having the

6th Lect 18/10/77

same forms as the first, are non-conductors, form alkaline bases & salts and insoluble and hard minerals and Bathy slages of a vitreous nature Boron. (B . 11)

is seldom seen it forms compounds with Hydrogen & Oxygen, and is always found accompanied with present or past volcanic action

Boric Acid ^(Borax) is obtained by a natural process and is produced in Incany Thet or South America either pure or as a Giborate of Soda or Lime.

When combined with Sodium it forms the Borate ($\text{Na}_2\text{B}_4\text{O}_7$)

Solution Boric Acid forms a green flame when added to fire

Borax yellows a flame

When burnt both Borax and Boric Acid turn to a vitreous substance which is coloured by others.

Tuesday Oct 23rd 1877
Lecture 7th

Silicon Si 28 Density 2.49

Silicon is a tetratomic element
It does not exist uncombined
but it is the principle element in the
stony part of the globe.

It forms an amorphous powder of
a dull brown colour burns when
heated in air

In its graphic state it contracts
when heated making hexagonal
scales, it also marks like plumlag
crystalline as quartz

With oxygen it forms a Dioxide
Silicic Acid SiO_2

Glass is composed of silicates if not
annealed the slightest fracture
ruins the whole lump.

It also forms the stiffening of
the plants in the veget. kingdom
especially in the Algae and -

yth Lect 23/10/17Silicon

Graminaceae

It is also found in the animal kingdom.

Flint glass is made from the Potassic Silicates and the Oxide of Lead it is more fusible than the others

Crown Glass contains no lead compound; but the Silicates of Lime Alumina & Sodium

Thursday October 25th 1844

Exp. By heating ^{heat &c} with water Sulphate of Ammonia and Slaked lime an alkaline reaction takes place; Ammonia being given off the the others combine.

The four great non metallic elements which form the whole organic kingdom are Hydrogen Nitrogen Oxygen + Carbon Nitrogen (N. 14) combines in various ways.

" combines with hydrogen as NH_3 NH_4

NH_3 is Anhydric Ammonia NH_4 Ammonium

It combine with oxygen in the following.

N_2O is Nitrous Oxide

N_2O_2 " Nitric "

N_2O_3 " " Sesqui oxide

N_2O_4

N_2O_6

Nitrate of Ammonia NH_4NO_3 when heated gives off

$NH_4 = \left\{ \begin{array}{l} N \\ H \\ H \\ H \end{array} \right\}$ with H_2O and Nitrous Oxide N_2O_2
by combination = $\frac{2H_2O}{+}$
 $NO_3 = \left\{ \begin{array}{l} N \\ O \\ O \end{array} \right\}$ NO_2

8th Lect 25/10/77

Nitrite of Ammonia may be formed by heating a piece of platinum wire red hot and placing it in Ammonia fumes in a glass vessel, the elements of the ammonia combining ~~separately~~ with the oxygen.

Tuesday November 6th 1877
19th Lecture

The Sulphur group is composed of Sulphur (S. 32) Selenium (Se 79.5) + Tellurium (Te 129)
They all combine with Hydrogen forming offensive & foetid gases.

Oxygen may be classed in this group but it stands rather apart.

Phosphorus + Nitrogen both form Acid compounds with Oxygen and gases with Hydrogen as NH_3 + PH_3

Chlorine Iodine Bromine + Fluorine form ^{acid} gases with both Hydrogen + Oxygen.

Thursday November 8th 1877
10th Lecture.

Sulphur. S. 32.

is largely diffused in nature united with Hydrogen or Oxygen. Nearly always found near present or past volcanic action. It is polymorphic, soluble in alkalis & has a great affinity for oxygen. When rubbed with Potass Chlor it forms a detonating mixture. When burnt in air produces Sulphurous Acid gas which is soluble in water and is possessed of bleaching powers. Soluble in alcohol ether oils and Carbon Bisulph. Water absorbs 50 volumes but can take more by pressure. Sulphuric Acid H_2SO_4 is manufactured from the Sulphuric Anhydride by the acid of Nitrate of Potassium.

11th Tuesday Nov. 20th 1877
11th Lecture.

The Marine Group

This group consists of Chlorine, a green gas, Symbol Cl Atomic Weight 35.5
Density 2.5.

Bromine an orange liquid Br. 80.
In vapour its density is 5.41 in liquid 2.98

Iodine is a blue-black crystalline solid with a metallic lustre
Sym. I. 127 Density of vapour 8.78 of liquid 4.947.

These are all bleaching bodies on account of their affinity for hydrogen. They also form acids with both oxygen & hydrogen, these acids however do not possess bleaching powers. If the Hydrogen be replaced by a base a neutral salt is formed.

Chlorine formerly called oxy-mur.

atic acid may be condensed into a liquid by cold or pressure

Bromine was first obtained from mineral springs but it and Iodine are now obtained from seaweed

Iodine forms a blue colour with starch
Bromine an orange

This group combines easily but they will readily decompose

Iodine combines with ammoniac forming an iodide of nitrogen; it is also combines with phosphorus by merely being placed in contact, combustion takes place and a Red Oxide of Phosphorus is generally left

Phosphorus may be burned under water by placing it in a vessel with Potass. Chlor. and pouring it on the Pot. Chlor a little Sulphuric Acid in a tube, an oxide of chlorine called uchlorine is formed which when placed on the phosphorus causes it to burn.

Tuesday Nov. 27th 1877
Lect. 12th

Phosphorus P 31. is a pale yellow solid something resembling ~~beeswax~~ ^{beeswax}. It is produced from bones burnt to whiteness and heated with dilute Sulphuric Acid Superphosphate Lime is obtained. By the addition of Carbon and by distillation the phosphorus is obtained. Another condition of Phosphorus called the Amorphous is obtained by heating Phosphorus to about 300°

Phosphorus combines with oxygen as Phosphoric Anhydride P_2O_5 and Phosphorous Anhydride P_2O_3 .

It also combines with Hydrogen in several proportions but not as ~~as~~ bases Phosphuretted Hydrogen may be obtained by heating together Potash Phosphate of Lime and Ether in a retort and allowing the gas

bubbles to pass through water and on contact with the air they burst into flame.

Phosphorus is highly inflammable and if burnt on a carbon substance it renders ~~it~~ it almost undurnable owing to the phosphoric acid formed. When burnt in air it forms white fumes soluble in water making Phosphoric acid. It is soluble in oils and ether.

Tuesday Dec 4th 1844
 Feb 13th

Metallie Elements

There are forty nine elements in this class. These generally produce Basic Oxides. They are opaque and conduct heat and electricity, reflect light and are electropositive. They are usually found as oxides Carbonates or Silicates or with Sulphur.

as pyrites a few are sometimes found in a natural state; they nearly all form soluble salts with the marine group

Potassium K. 39. Density 0.865
This metal occurs abundantly in nature but only in combination. It is obtained from the ashes of plants and from rocks in Germany. It can be obtained by heating cream Tartar. It is white in colour with a blue tinge and readily oxidizes. taking fire when placed with either water or ice

Thursday Dec 13th 1877
14th Lecture

Calcium, Barium, Strontium

A decreasing solubility of the Sulphates may be marked from Sodium Sulphate to Barium Sulphate.

Calcium Ca. 40. Density 1.57 It is largely found as a carbonate though it frequently occurs combined with acids. The metal is seldom seen owing to its difficulty of preservation

Oxide of Calcium (CaO) or Quicklime is obtained from Calcium Carbonate by heat as $\text{CaCO}_3 = \text{CaO} + \text{CO}_2$

This oxide is not more soluble in hot than in cold water

Calcium Carb is largely used; the most common form is Whiting and the next coarsest the Creta Preparata Creta Precipitata is made by heating lime to Hydrochloric Acid and precipitating with Sodae Carbonas

13/12/77
Lect.

Sulphate of Lime is in its most common state known as plaster of Paris. It is only soluble 1 part in 460.

A solution of this salt causes a precipitate with solutions containing Barium Strontium or Lead. Phosphates of these several are known the most important being the bone-earth or trisarc phosphate. If Acid Sulphuric be added to remove $\frac{2}{3}$ of the Lime the Superphosphate is left.

Another Salt is the Calcium Chloride CaCl_2 or Oil of Lime. Lime exhibits strong affinities for Soap and Carbonic Acid. Caustic Lime takes all the Acid from the Carbonates of the first group of metals. When combined with Acid Carbonic it is not alkaline.

Barium Ba 137 occurs as a carbonate
in the substance called Witherite

Its oxide does not absorb Carbonic acid
as Lime does. A higher or peroxide of
Barium is also known. It is poison-
ous and has been used as a vermin-killer

Strontium Sr 87.5 Density 2.54.

This is also found as a carbonate. Its
oxide is made from the nitrate

Strontium Chloride is crystalline and
soluble in water and Alcohol

Lime burns with an orange red flame

Barium " " a green "

Strontium " " red "

Tuesday Decr 18th 44

Zinc Zn 65.5.

This metal is found either as a Sulphide (Blende) or a Carbonate (Calamine). Calamine is seldom pure being associated with Arsenic, Zinc ores are seldom pure mostly containing Iron Antimony &c. It readily alloys with mercury and forms a compound which does not dissolve in Dilute Acid Sulphuric and is as useful for batteries as the pure metal.

Zinc is prepared from Calamine by heating the mineral with Coke till it slightly volatilizes and passing it into water.

Calamine is often mixed with Barystal Carb. Zinc Sulphate and Carbonated Potash form a precipitate of the Carbonate & Hydrated Oxide of Zinc which is generally impure on account of Acid Salt formed.

Zinc heated forms an Oxide, it has however less affinity for Oxygen than Magnesium has.

The Sulphate resembles that Magnesium so closely that the eye fails to distinguish them.

Its Chloride has been introduced as a disinfectant, but many deaths from mistakes have occurred.

Its chlorides and Oxides are soluble.

A solution of Oxide Zinc is precipitated by Ammonia and then redissolved. With Hydrosulphuric no precipitate. Ammonia added Zinc Sulphuret is formed. If the metal is heated & Sol Cobalt green is formed. Its Iodides are used in Photography.

Cadmium Cd 112 is largely associated with Zinc but is more volatile fusing at 315° and distilling at 450° Cent. It is precipitated from solution by Sulphuretted Hydrogen. Its Iodides & Bromides are used by photographers.

Tuesday Jan'y 8.th 1848.
16 Lecture

The Elements are divided into two groups the Metallic & nonmetallic
Hydrogen is classed among the metals
They may also be divided into
Alkaline Metals

Those forming Alkaline Earths
Earths

Rusting Metals

Those forming Acid Oxides
" " doubly Basic "

Noble Metals

They are also grouped in relation to
atomicity

Monatomic Elements as Lithium

Ammonium Sodium Potassium
Argentum

Diatomic Calcium Strontium

Barium - Magnesium Zinc Cadmium
Copper Mercury and Lead

Triatomic Aluminium Chromium
Iron Cobalt Nickel Manganese these
form proto and Sesqui Salts
Also Uranium Vanadium Gold Thallium
Molybdenum and Tungsten - Tin and
Titanium

Tetrahatomic as Palladium Rerbidinum
Cesium Indium Platinum etc
Pentatomic as Arsenic Antimony &
Bismuth

Phosphates of the first are soluble
salts. Calcium and Magnesium Phos-
phates are soluble in Acid solutions
but are thrown out by Ammonia.

Thursday Jan'y 10th / 78
17th Lecture

Copper Cu 65

Found as Silicate and Carbonate
also in the shape of pyrites frequently
accompanied by Arsenic. These roas-
-ed are used for Acid Sulphuric
the remainder ^{cuprous} Oxide is used
for extracting metallic Copper

Copper also forms a Peroxide

To a solution of Cupric Sulphate
add an Alkali also Glucose and
then Boil Cu_2O is thrown down
A similar solution with an alkali
throws down verdigris By boiling
an oxide is formed

Its Nitrate heated forms a
black Oxide

Ferricyanide of Potash forms a
fory colour with it

With Iodide of Potassium Cu_2I_2

Pais Green is also an arsenious salt
of this metal

Tuesday Jan 15th 1844
18th Sect.

Mercury. Hg 200. Sp. G. 13.6.

This is a well known metal and
has been in use for many years
being known to the ancients

It is light silver coloured very
fluid extremely mobile and one
of the heavier metals

It boils at 660° Far. or 330° Cent
and Solidifies at 39° below.

It is found native or as Cinnabar
a Sulphide of a red brown colour
Used largely as medicine and in
various manufactures; also in
the battery.

Thursday. 17th Jan'y 47
19th Oct.

Mercury does not readily oxidize
but is susceptible to Sulphur
Heated it turns to the anhydrous
red oxide HgO .

With Subsalts of Mercury and an alkali
a Suboxide is precipitated $Hg_2O(H_2O)$.

With a persalt a yellow precipitate
is formed which is also an oxide

Mercury forms a double series of salts
With dilute Nitric Acid a solution
of ~~Mercuric~~ Mercuric Nitrate $Hg(NO_3)_2$ is
obtained. It also shows a disposition
to form Persalts.

Its Chlorides may be prepared from
Salt and Mercurous Sulphate.

Ammonia added to the Chloride
Solution forms the white precipitate
Hyd Ammon Chlor.

Mercuric Chloride ($HgCl_2$) + Iodide of Potassium 2 K I. forms the Bismuthide HgI_2 a reddish powder heated it turns yellow when rubbed regains its red

Lead Pb. Weight 207 Density 11.45

Lead has been known for many years being mentioned in Scriptures and ancient authors.

The principle ore is its Sulphide called Galena found in England & Spain. It is crushed and washed and finally roasted. The air being cut off and the heat raised turns it into the metal and into Sulphurous anhydride. Lead is malleable though not ductile. It melts at 330° and also when strongly heated vaporizes. It is largely used for domestic and other purposes and it is frequently alloyed to make it harder. It oxidizes in air or water

if the water is free from saline matters
 It forms several oxides the common oxide or
 Litharge which is of a pale brick colour and
 is used in the preparation of lead plaster
 Red Oxide Pb_3O_4 used as a pigment
 and the peroxide PbO_2 . Another salt much
 used is the carbonate $PbCO_3$ sometimes
 found pure; it is used as a pigment
 Plumbic Nitrate $Pb(NO_3)_2$. Plumbic
 Acetate $Pb(C_2H_3O_2)_2$ or Sugar of
 Lead is prepared by dissolving litharge
 in Vinegar. It is used in various
 preparations of the Pharmacopoeia
 Lead Salts are poisonous.

Tests Sulphuric Acid gives a very
 insoluble precipitate of the Sul-
 phate of Lead

Potass Chrom produces a yellow
 precipitate with a solution of Lead
 Salts.

Triatomic Group

These metals are Aluminium Chromium
Iron Cobalt Nickel and Manganese
They form Sesquioxides so called because
for every equivalent metal there is $1\frac{1}{2}$
of Oxygen. They combine with Chlorine
1 to 3.

Aluminium At Weight 27.5 Density
2.6 This is a rather abundant ele-
ment chiefly associated with oxygen
or Silicon. It is a bluish white
metal malleable and ductile and
does not tarnish and scarcely oxidizes.
Its chief salts are its Sulphate $Al_2(SO_4)_3$
and its combination as common alum
or Sulphate of Aluminium and Potassium
 $Al(KSO_4)_2 \cdot 12H_2O$. It forms large regular
crystals. It is astringent and also acid
and is largely used in dyeing and in
medicine.

Chromium Cr 52.5 Density 7

This metal is noted for the beauty of its various compounds. Its name is from the Greek χρωμα Colour. It forms a long series of combinations with oxygen. Its compounds are obtained from chromic iron ore $\text{FeO} + \text{Cr}_2\text{O}_3$. As a metal Chromium is little known. Chromic Anhydride (Cr_2O_3) or Chromic Acid is the highest oxide made by mixing a solution of Dichromate of Potassium with strong Sulphuric Acid. The oxide is thrown down in beautiful crimson needles. If placed in water it forms chromic hydric Chromate. This ~~salt~~ is the type of a series of salts called Chromates such as Potass. Chromas. K_2CrO_4 a yellow crystalline salt. Potass. Dichromas. red crystals

Tuesday Feb 5th 1878

Ferrum Fe 56 Density 7.8

Iron is found in great abundance and is probably the most useful metal of all. It has been long known being mentioned in Genesis. It is sometimes found native and is frequently obtained very pure in the meteoric bodies. It is also obtained as the black oxide Fe_3O_4 abundant in Sweden and North America and is called magnetic iron or contains about 72 per cent of iron.

The haematite or red oxide Fe_2O_3 in Cumberland & Germany. Its carbonate FeCO_3 and its sulphide FeS_2 or pyrites which are frequently associated with arsenic. Iron is purified by smelting.

Iron is diatomic forming a protoxide and its salts are double the ferrous or ferric.

Thursday Feb 6th 1878

Ferrous Carbonate FeCO_3

Sulphate FeSO_4 or green sulphate of
commerce light green it slowly oxidizing
if exposed. This is used in the arts and
in the manufacture of black ink.

The tests for ferrous salts are

Potass Prussiate flav. gives a blue white precip-
itate rapidly changing to dark blue

Red Prussiate gives a deep blue at once

Sulphide of Ammonia gives a black
precipitate

Thursday February 14th 1878

Pentatonic Group.

Bismuth Arsenic Antimony

Bismuth alloyed with other metals
reduces the melting points

Antimony possesses the same quality
Bismuth forms a pentachloride
with HCl . BiCl_5 . When a solution
of either a Chloride or Nitrate is
poured in water an acid salt is

precipitates while a basic salt remains
in solution

Chloride of Antimony also acts in the same
manner

Arsenic is found associated with many
ores

46

50

Notes Chemistry

Nonmetallic Elements

fascous Hydrogen Oxygen Nitrogen
Fluorine Chlorine

Liquid Bromine

Solid. Iodine Boron Silicon Sulphur
Selenium Tellurium Carbon
Phosphorus

Oxygen O. 16 Sp. g. 1.1036

It is a colourless tasteless inodorous gas, soluble in water to the extent of 3 volumes in one hundred.

It is the most abundant element known $\frac{9}{8}$ of water and about $\frac{1}{3}$ of the air being oxygen.

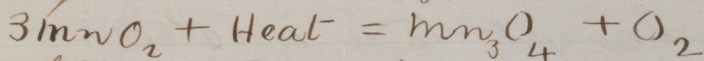
It was discovered by Priestley in 1774 and Scheele 1775.

Most oxides yield it by heat.

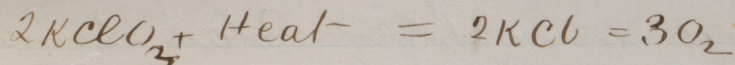
Red Oxide of Mercury being about the best.

Di

Mangan. Oxide with heat also gives large quantities of



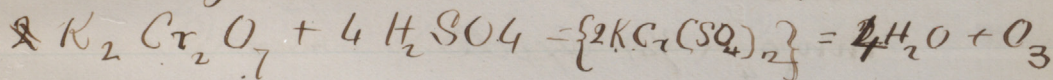
Chlorate Potass heated also gives Oxygen



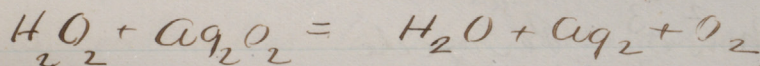
Chlorate of Potass and the Peroxide of Manganese yield it better together care being taken that they are pure

a clear solution of Chloride of Lime (B.P.) with Peroxide of Cobalt also yields gas

Potass Bichrom + Acid Sulph



also



Oxygen supports combustion and forms compounds with all elements but Fluorine

an alkaline solution of Pyrogallie acid turns black with oxygen

Ozone this is by some said to be the negative atom of Oxygen Gas and that the positive has yet to be isolated

It can be obtained by adding Powd Oxalic Acid to a Solⁿ of Potass. Permang. It is an oxidizing agent and bleaches vegetable colours

Oxygen forms many oxides with different metals and with some it forms a long list as

MnO	Protoxide	Manganese
Mn_3O_4	($\frac{3}{4}$) Oxide	"
Mn_2O_3	Sesquioxide	"
MnO_2	Peroxide	"
H_2MnO_4	Manganic acid	
$HMnO_4$	Per -	"

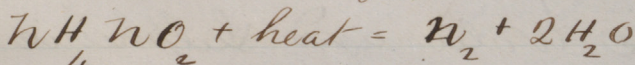
Nitrogen

N 14 Sp.G. .9713

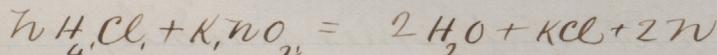
This element was discovered by Rutherford in 1772 and it is peculiar from the difficulty of making it combine or stay in combination with other elements. Lavoisier called it Azote because of its action on life. It extinguishes both life and fire.

It can be obtained from

Nitrite of Ammonia



or Muriate of Ammonia Nitrite of Potash



It is colourless tasteless and odourless and it is soluble to $\frac{1}{50}$ of its bulk in water. Air contains by vol O 20.81 N 79.91

weight O 23.01 N 76.99

100 cubic inches Air = 31.074 lbs

1 foot = 536.95 "

Air contains

O	20.61
N	77.95
CO ₂	1.04

Aq. Vapour 1.40

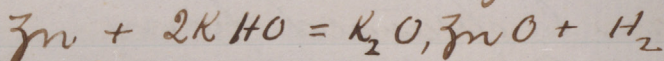
NH ₃	Carb. Hyd	Sulphurous Gas	} Traces.
HVO ₃	Sulph.		

Hydrogen

H . 1. Sp. G. 0.0692

First noticed by Paracelsus in 1600
but discovered and named by Cav-
endish in 1766 as Inflammable
air.

Made be made by passing steam
over hot iron turnings or by
Zinc and solution of Potash



It may also be obtained from
Zinc Water and Sulphuric Acid

It is colourless tasteless odourless
and inflames readily

It is the lightest and most
refractive gas.

100 c.c. ^{grammes} water take up 1.93 Hydrogen

It possesses the property of raising
the tone of the voice

Carbon C . 12

Carbon is an amorphous substance and is largely distributed

Diamond is about the purest natural state. They are very hard and belong to the cubic system of crystals. Their specific grav is about 3.3. Found chiefly in old alluvial deposits. They also contain a little Silica + Peroxide of Iron

Graphite or Plumbago Sp. Gr. 2.2 is the source of the lead pencil is also a form of carbon. Found in Cumberland United States, Ceylon Canada. Coal is a less pure state than ~~even~~ Graphite containing Hydrogen Oxygen Iron Sulphur Nitrogen and earthy salts. Coal heated gives off gas and leaves a substance Coke. Charcoal can be obtained from the burning of oil or by slowly charring wood without air.

^{Charcoal}
Carbon possesses great powers for absorbing gases consequently it makes a good disinfectant

It also discolors solutions filtered through even removing to a great extent all organic matter in them Charcoal from blood is the best for decolorizing

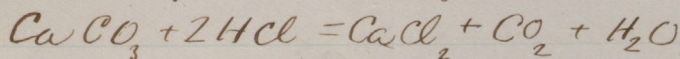
Carbon also deoxidizes changing Mercuric or Ferric Salts into Mercurous or Ferrous. It combines directly with Oxygen Hydrogen Sulphur

Carbonic Gas CO_2 44 Sply 1.529
called Carbonic Anhydride or Carbon Dioxide is a colourless gas with an acid taste and smell noninflammable and does not support combustion
100 cubic inches weigh 47.403 grs

It liquefies at 32° Fahr under the pressure of 32 or 34 Atmospheres
Water dissolves its own bulk

It can be prepared from any car-

bonate by means of an acid as



Carbonates except the alkaline ones are insoluble in water

Carbonic Gas added to water assists in the solution of many. Carbonates yield up gas when treated with ^{a mineral acid} ~~ammonia~~ leaving salts of that acid

Lime water or a Subacetate of Lead solution grow milky if CO_2 is passed through them. The acid radicle is bi-basic forming Carbonates and Bicarbonates as

Na_2CO_3 carbonate Soda

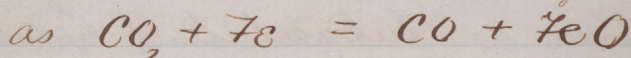
KHCO_3 Bi " " "

Carbonates also combine forming double carbonates.

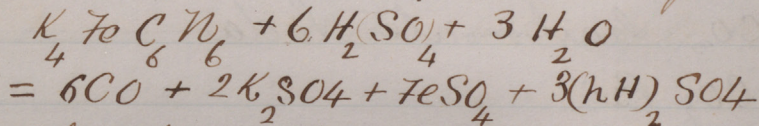
Carbonic Acid Oxide

CO - 28

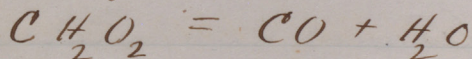
Discovered by Priestly about 1690 but was not much understood till examined later by Woodhouse
 Charcoal heated with Peroxide of Iron yields it. Carbonic Acid Gas passed over red-hot Iron also gives the oxide



Ferrocyanide of Potassium and Acid Sulphuric heated gently with a little water also yield the gas



Also from Formic Acid



Colourless transparent Neutral to vegetable colours Water dissolves $\frac{1}{40}$ of its own bulk; burns with a blue flame

One volume contains half a molecule of Oxygen.

Carbonic Oxide unites with Chlorine as COCl_2 or Phosgene gas

Carbon will not unite directly with Chlorine but can be made to by substitution as Marsh gas C H_4 , the H_4 may be replaced by Cl_4 forming CCl_4 Tetra-chloride Carbon. Carbon combines with Sulphur as a bi-sulphide CS_2 . Heat Charcoal to a red heat in a vessel with a long spout and then drop in Sulphur the Bisulphide drops through.

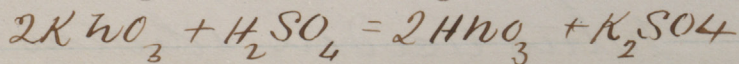
Its Sp. G. is 1.293 Burns readily boils at 46°Fahr . Dissolves Sulphur Iodine & Phosphorus.

Nitric Acid

Monohydrated HNO_3 1.517 first examined by Cavendish

Electric Sparks through moist air & hydrogen yield Nitric Acid

Nitrate of Potash (or Soda) and Sulphuric Acid as $\text{KNO}_3 + \text{H}_2\text{SO}_4 = \text{HNO}_3 + \text{KHSO}_4$ or



The Pharmacopeia Acid contains about 60 pc of the anhydrous acid H_2O_5 . Anhydrous may be obtained from nitrate of Silver and Chlorine by heat ~~as~~ yield H_2O_5 but the ~~act~~ decomposition is not known. It is a silky crystalline substance the dry salts are not corrosive. Diluted nitric acid is best for metals as a solvent.

Impurities are Sulphuric Acid a Solution of Barium Chloride will at once precipitate H_2SO_4 from the Nitric Acid.

Muriatic Acid this is precipitated by Chloride^{nitrate} of Silver as Chloride. For Iron or Potassium evaporate to dryness.

Nitric Acid is monobasic.

It is not precipitated by anything as its salts are soluble.

Nitric Acid in solution may

be detected by putting a crystal of Sulphate of Iron in the liquid and carefully adding Acid Sulph. A dark cloud is formed as $6\text{FeSO}_4 = 2\text{HNO}_3 + 3\text{H}_2\text{SO}_4 = 3(\text{Fe}_2\text{S}_2\text{O}_8) + 2\text{H}_2\text{O} + 4\text{H}_2\text{O}$ or heat the Acid with copper and red fumes are given off

Bruceia reddens with Nitric Acid
 Nitrous Oxide Laughing Gas

H_2O 44 spg 1527

Nitrate of Ammonia + heat = N_2O

as $\text{H}_4\text{N}_2\text{O}_6 = \text{N}_2\text{O} + 2\text{H}_2\text{O}$

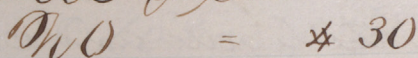
transparent colourless, sweetish

Soluble to the extent of 130 pts to 100 of Water. Used as an anæsthetic.

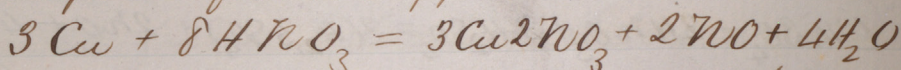
Relights a smouldering match.

Is easily respirable.

Nitric Oxide



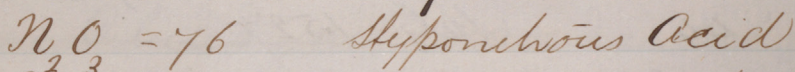
Prepared from Copper and Nitric Acid



A neutral colourless gas with a disagreeable taste reddening with oxygen.

Water dissolves one thirtieth of its bulk

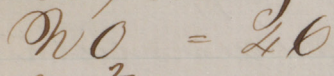
Nitrous Anhydride



Prepared from 1 part Starch and 8 pts Acid Nitric 1.25 heated together. Passed over Chloride of Calcium fused, at zero Fahr it turns into a blue liquid. Dissolved in Water it forms Nitrous Acid HNO_2 . It destroys the colour of Indigo and Potass Permang. Changes Potass Bichrom to the green Chromium Salts

Starch Iodide of Potassium and a little Hydrochloric acid give a blue colour with it or with nitrites

Peroxide of Nitrogen



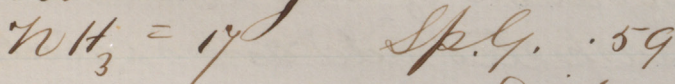
Can be condensed into a liquid boiling at 71° Fahr

Nitrate of Lead + heat yields this gas
 $2(\text{Pb}_2\text{NO}_3) + \text{heat} = 2\text{PbO} + 4\text{NO}_2 + \text{O}_2$

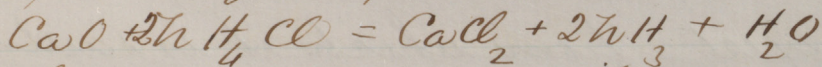
A suffocating gas, supporting combustion Potassium inflames spontaneously if placed in it

Forms a red transient colour with Sulphocyanide of ^{Potassium} Mercury.

Ammonia Gas



Gaseous Ammonia and its salts are formed from the gas liquor from coal distilling. Caustic or Slaked Lime and Sal Ammoniac will yield gas if mixed, equal parts are best.



13 Sal Ammoniac yields 380 cubic inches gas. It is colourless with a pungent odour and is fatal to life

if required. It does not support combustion but if heated burns with a pale green flame. Soluble in water at 32 Fahr to the extent 1050 times the volume of the water. Condenses at -103° Fahr to a solid and to a liquid at -40° . Has a strong alkaline reaction and neutralizes strong acids. Solution of Ammonia freezes at -40° into a nonodorous gelatinous mass. No residue should be left by the evaporation of this solution. If lime is suspected add an oxalate and heat to a carbonate and if it effervesces ~~burn~~ with an acid lime is present. A compound body
 Ammonium

is believed by many to exist from which it is said the salts are made. As the salts are isomorphous with the Potassium and Sodium salts and the

same alkaline reaction is found in the three classes it is supposed that the body exists

Further the salts have the same composition as regards the quantity of acid in the different ones as

Hydrate of Ammonia $NH_3^{H_2O}$ may be written
 NH_4HO Potassium Hydrate KHO Potas
 Hydrate of Ammonia NH_3H_2O or $(NH_3)HO = (K)HO$
 Chloride " " NH_3HCl or $(NH_4)Cl = (K)Cl$
 Acid Sulphate " $2NH_3H_2SO_4$ or $(NH_4)HSO_4 = (K)HSO_4$

An Amalgam of Sodium and Mercury placed in a solution of sal ammoniac swells many times its own bulk.

Chlorine

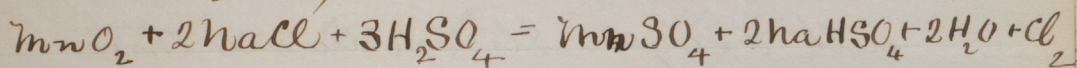
Cl

35.5

Sp. G. 2.47

This element with Iodine Bromine and Fluorine form a group called halogens; they are never found free. Chlorine was discovered by Scheele in 1774. It is a transparent greenish gas with a suffocating taste and smell. 100 cubic inches weigh about 74 grains. It liquefies under 4 atmospheres at about 60°Fahr to a liquid 1.33. It is soluble in water to half its bulk. ~~Not~~ combustible nor is it a supporter of combustion. Phosphorus and several other elements burn spontaneously in it. Spts Turpentine does so also. It occurs largely combined with Sodium. Chlorine is a bleaching agent, removing the Hydrogen from bodies by com-

lination and replacing it
Salt Sulphuric Acid and Mangan-
ic Binoxide heated produce it

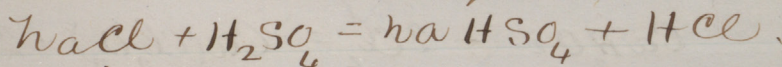


Chlorine combines with all metals
the chlorides are soluble with few
exceptions. As a rule there is a
chloride for every basic oxide. Free
chlorine dissolves gold leaf

Hydrochloric Acid Gas

HCl 36.5 Sp. g. 1.24

Solutions of Chlorine gas turn to the
acid if kept. This acid may be made
from Salt and Sulphuric acid



A white irritant gas 100 cub inches
of which weigh 39.6 grains. Liquefies
at about 50° Fahr under 40 atmospheres

Neither burns nor supports combustion

Water at 40° Fahr absorbs about
480 times its bulk and swells $\frac{1}{3}$.

Oxides of Chlorine

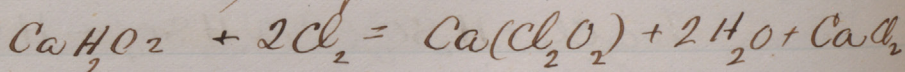
Chlorine does not combine directly with oxygen. Its oxides are three

Cl_2O Hypochlorous Anhydride

Cl_2O_3 Chlorous "

ClO_2 Peroxide of Chlorine

A molecule of water added to the first forms Hypochlorous Acid $\text{Cl}_2\text{H}_2\text{O}_2$ a powerful oxidizer. Chlorine gas passed over Oxide of Mercury yields the Cl_2O . Hypochlorous acid forms the Hypochlorites. Bleaching powder is an example as



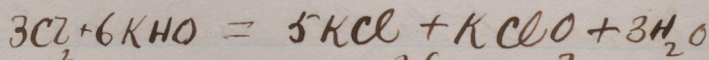
Slaked Lime

Bleach. Powd.

Chloric Acid HClO_3

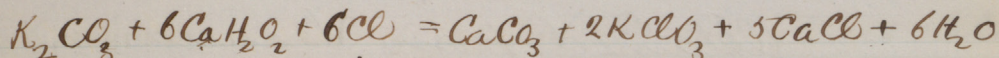
The acid radiate of the Chlorates.

To form Chlorate of Potass ~~or~~ Slaked Lime and Chlorine are used as



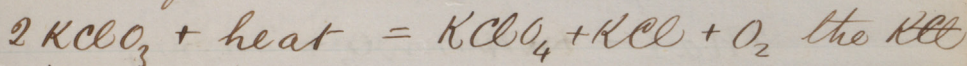
Chloride } { Chlorate

But as the waste of Potassium is large
Potash Bark and Slaked Lime are used as



Perchloric Acid chlorate

Obtained from Pot Chlor by heat. $HClO_4$

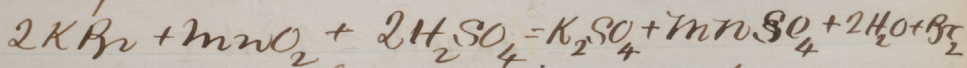


$KClO_4$ being its salt of Potassium

A body known as Chloride of Nitrogen
a violent explosive is also made its
formula probably being HCl_2N, Cl_3N

Bromine $Br 80$ sp. g. 3.187

A liquid element from seawater
discovered by Balard in 1826. The
Bromide is obtained and then heated
with Dioxide of Manganese and Acid
Sulphuric



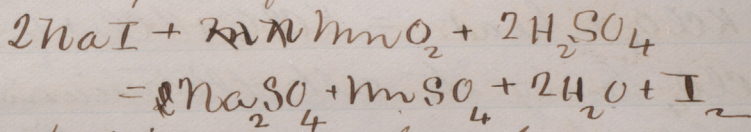
Bleaches like Chlorine. Hydrobromic
Acid is now used in medicine.

HBr being the formula. Bromine
in Solutions is freed by Chlorine
and then shown by Carbon Bisulph
or Ether.

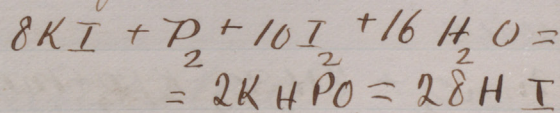
Iodine $\underline{I}$ 127 Sp G 4.94

Discovered by Courtois 1811

Obtained from Seaweeds, in a combination chiefly with Sodium may be free as the Bromine



Iodine is a solid fusing at 270° and boiling at 347° Fahr. Chlorine fuses it in combination and starch turns blue with it. Lead salts give a yellow and Bichloride of Mercury a red precipitate with and Iodide Hydroiodic Acid HI is made as follows



Iodates blue with Tartaric acid while Iodides do not.

If a solution of Iodine Bromine and Chlorine is mixed they may be detected by ~~Red~~ precipi-

tating the Potash with two parts Sulph-
 of Iron and one of Sulph Copper
 Nitrate of Silver precipitates the others. Silver
 chloride is soluble in Ammonia

Fluorine $\frac{7}{19}$ Sply 1313

This ^{element} ~~metal~~ has never been seen ~~not~~
 nor an oxide of it. It is found as
 Fluor Spar in combination with
 Lime CaF_2 . An acid hydrofluoric
 is used in etching glass {147 20}
 $\text{CaF}_2 + \text{H}_2\text{SO}_4 = \text{CaSO}_4 + 2\text{HF}$. A volatile
 instant colourless acid Sply 1.06
 Should be made in lead apparatus.

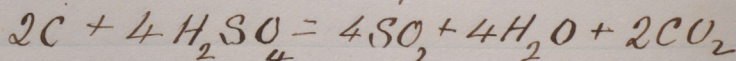
Sulphur S. 32

Sulphur is found native combined with Iron Copper Arsenic etc in the form of Sulphides. Sulphur is ^a non conductor of ^{electricity} heat and if rubbed becomes neg. electr. Specific gravity about 2.05. Sulphur is allotropic being known in crystal also in an amorphous powder and if heated and slowly dropped in water forming a plastic mass with a density of 1.96.

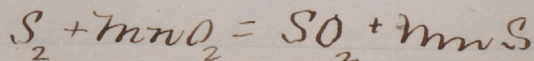
Sulphur forms compounds with Iodine & Chlorine

Sulphurous Gas SO_2 64

An easily condensable gas Density 2.247. ~~It~~ ^{can} be made from Carbon and Sulphuric Acid



or from Sulphur and Binoxide of Manganese



This gas bleaches colours but ammonia restores them it is also a disinfectant
A solution of this forms the sulphurous acid H_2SO_3 of the Pharmacopoeia

Sulphuric Acid H_2SO_4 98

This acid used largely in chemistry is prepared in large leaden chambers from heated Sulphur and nitric Acid with air and steam. Sulphurous gas is first formed which unites with one molecule of oxygen from the nitric acid forming the Sulphuric

$3H_2SO_3 + 2HNO_3 = 3H_2SO_4 + H_2O + 2NO$ and the nitric oxide formed unites with the air and water forming nitric Acid again. Wadhausen acid the strongest Sulphuric if distilled yields water and anhydrous Sulphuric Acid SO_3 . Iron Lead. Sulphur Gas are impurities. Sulphocyanide of Potassium detects Iron, water lead

Hyposulphurous Acid $H_2S_2H_2O_4$

Pass Sulphurous gas through a Sulphide

solution.

Hyposulphuric Acid $H_2S_2O_6$

The tests for Sulphates is Chloride of Barium. Insoluble precipitate in HNO_3

Sulphides are tested with a mineral acid Sulphuretted Hydrogen being freed Sulphites with mineral acids Sulphurous acid being freed

Hyposulphites mineral acids give off SO_2 and Sulphur is precipitated

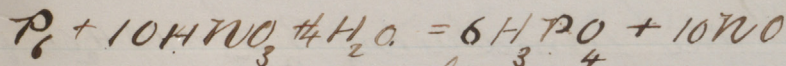
Hyposulphates no change with mineral acids unless heated then SO_2 is freed.

Phosphorus. P. 31 Sp.G. 1.83

Discovered by Brandt in 1669. Exists in bones as Phosphate of Calcium. It is a nonconductor. Soluble in Ether Turpentine Carbon Bisulph and Oils. It is luminous and allotropic. By heating it to about 300° it turns red and forms the amorphous Phosphorous. 2/3

Phosphoric Anhydride P_2O_5

The ordinary Phosphoric Acid is made by heating Phosphorous and Nitric Acid together



$H_3P_4O_4$ or Orthophosphoric is the acid of the Pharmacopeia, it gives a yellow precipitate with tincture of Silver

$H_2P_3O_3$ or Metaphosphoric Acid gives a white precipitate with $AgNO_3$ but coagulates albumen

$H_4P_2O_7$ or Pyrophosphoric Acid gives a white precipitate with $AgNO_3$ but ^{does} not coagulate albumen

Boron B 11

Discovered by Davy in 1808. Is allotropic
Largely found as Boracic Acid or
as Bencal. It is found in all
volcanic regions especially in
Italy near Tuscan

Boracic Acid HBO_3 1.48

Obtained largely from the volcanic
districts in Tuscan, it reddens

Turneric paper and turns green

Sometimes used to adulterate Salicine

Borax or Borate of Soda with
the formula $\text{Na}_2\text{B}_4\text{O}_7 + 10\text{H}_2\text{O}$ found

native but requires purifying it
is soluble in 2 parts hot water and

in 12 cold. If a solution of Sulph-

uric Acid is added to it, Sulphate

or of Boron Soda is formed and

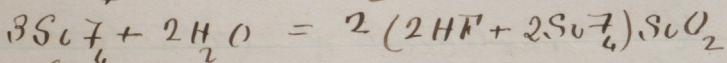
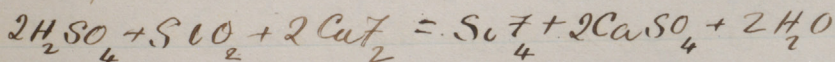
the Boracic Acid set free

Silicon Si 28

The most abundant element, it is allotrophic. Its oxide Silica or Silicic acid is the base of many rocks. It is nonvolatile Soluble only in hydrofluoric Acids. It is the base of Glass.

The best Bohemian has Silica Potassium and a little Magnesium & Sodium. Another variety of Bohemian has aluminium in addition. A third has Calcium Sodium and Silica, Plate glass. ~~has~~ Carboy glass has Iron ore and other impurities. Flint has lead and Potassium. Glass is slightly soluble in water.

Silicofluoric Acid is a compound of Sulphuric Acid Spar and Silica



Selenium 79.5 sply 4.7 Berzelius in 1817 found as Selenides of Lead & Copper in Mexico & Sweden. Sublimis scarlet

Tellurium 129

Exists as tellurides in Hungary
 remarkable for the strong disagreeable
 odour it gives to a person who is
 down with it. Along with Selenium
 it forms one of the Sulphur group
 and its chemistry is similar

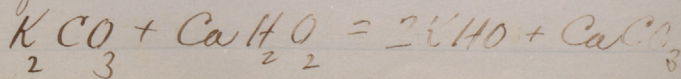
Potassium

K 39

Spec Grav. 865

Fuses at about 144° Fahr, found in
 Alum Telepar Unica. Oxidizes so readily
 that it must be protected by a hydro-
 carbon. ~~It~~ Inflames if placed in
 water. Discovered by Davy 1807.

Made be made by decomposing Bit-
 tarate of Potassium with Carbon
 Its oxide has the formula K_2O this
 with a molecule of water forms the
 Caustic Potash $K_2O + H_2O = 2KHO$
 or from Pot. Carbonate and Hydrate
 of Lime



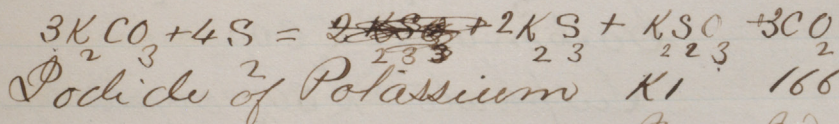
If Silica be present in the caustic potash
an excess of ~~Caustic pot~~ Acid will precip-
itate it out.

Alumina and Iron neutralize the solution
and add sol of Ammonia. Lead heat
for with Sulphuric Acid

Oxalates will detect Lime the precipitate
being soluble in Acid Hydrochlor not
in Acetic. Potassium is found in woods
principally as carbonate though sulph-
ate and Chloride are formed

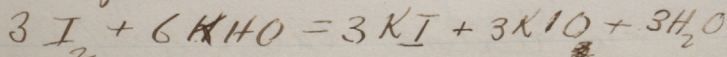
Sulphide of Potassium K_2S B.P.

Mr Watts gives the formula for the
above as K_2S_3 his way is as follows
with Carbonate of Potash and Sulphur

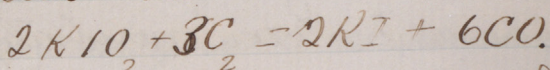


Iodide of Potassium KI 166

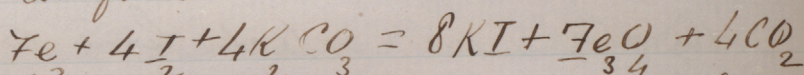
Can be prepared from Iron Iodine
solution $Fe + I + H_2O =$ Iodide of Iron
then add Potash Carbonate like
As from Iodine and Caustic Potash



The Iodate KIO_3 may be ~~transformed~~ changed to Iodide by heating with Carbon



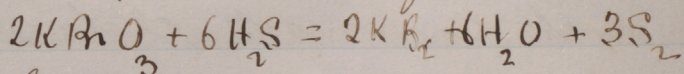
Like's formula condensed is as follows



Iodates turn blue with Acid Tart and starch

Bromide KBr

Obtained like the Iodides ~~by~~
By passing Sulphuretted Hydrogen through Bromate of Potassium the Bromide is formed



Carbonate K_2CO_3

Sulphate K_2SO_4 crystallizes out in making Carbonate from wood

Chloride of Platinum forms with the Chloride of Potassium a reddish Chloride of both.

The Bisulphate KHSO_4 is the residue from making Nitric Acid.

Nitrate of Potassium KNO_3 is found largely native but requires purifying.

Sodium

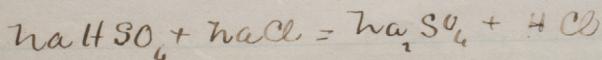
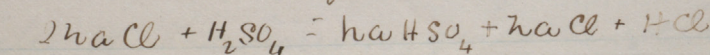
Na 23 sp. g. 972 Fuses at 207°

Discovered by Davy in 1807

Largely found as salt Na_2CO_3 Cryolite -
Cubic habit

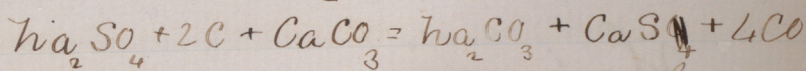
Sodium Chloride NaCl a common salt soluble in three parts of water deliquesces if heated and is the source of the Na^+ salts. A subchloride Na_2Cl_2 can be formed. Its combinations with Iodine and Bromine are like the Potassium salts

Sulphate $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ or Glauber salt or $\text{Na}_2\text{S}_2\text{O}_4$ Mirabilite a by product in the manufacture of the Carbonate



Sulphate Sodium Na_2SO_3
 Nitrate " NaNO_3 found in
 Chile as cubic nitre

Carbonate $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$

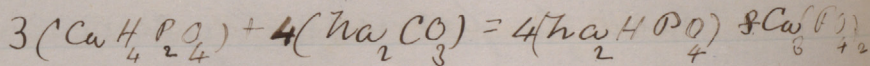
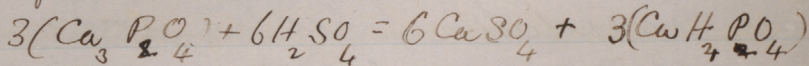


The acid carbonate or washin,

soda is insoluble in spirit NaNHCO_3

If Sulphide is present in the carbon-
 ate lead or Bismuth give black
 precipitates

Phosphate $\text{Na}_2\text{HPO}_4 \cdot 12\text{H}_2\text{O}$ from phosphate
 of Lime and Acid Sulph.



Ammonium Chloride NH_4Cl

This chloride changes such salts as Stannates, Arsenites and Antimonials to volatile chlorides.

If heated with the oxides with a formula similar to FeO it forms solid chloride.

NH_4NO_3 Nitrate of Ammonia melts at

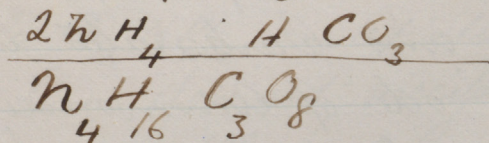
246° Fahr. NH_4NO_2 heated splits into laughing gas $2\text{H}_2\text{O}$ and water H_2O

$\text{NH}_4\text{H}_2\text{C}_2\text{O}_8$ the commercial carbonate of ammonia made by subliming chalk.

CaCO_3 and chloride of ammonia NH_4Cl

It consists of two molecules of true carbonate $2\text{NH}_4\text{HCO}_3$ and one of ~~one~~ a carbonate called Carbamate NH_4

NH_2CO_3 as $\text{NH}_4 \cdot \text{NH}_2\text{CO}_2$



The principle impurities of the above are found as chlorides and sulphates. Chloride of Platinum gives a yellow precipitate with ammonia which

if heated leaves platinum.

Barium Ba 137 Davy.

a yellow metal forms a basic oxide BaO also an other one BaO_2 . A sulphide of Barium may be prepared by heating the sulphate with Carbon

Barium gives a green yellow to flame. and its salts are precipitated by sulphates Phosphates and Carbonates but not by sulphide of Ammonium. They are also poisonous. Its Chloride $BaCl_2$ precipitates with the yellow chromate of Potash.

Strontium. 87.5 Sr. Sply 254

Forms no peroxide. ~~not~~

tribate Sr_2NO_3 is largely used for colouring fires it gives a red tint

Its salts are **not** poisonous and the do not precipitate with Potas. chrom.

With Sulphate of Calcium it gives an immediate precipitate

Calcium Ca 40

Yellow and malleable forms only one oxide CaO which with a molecule of water gives CaH_2O_2 Slaked Lime

Its sulphide CaS is used as a depillatory. Carbonate CaCO_3 is found largely native as marble chalk etc. Its

phosphate $\text{Ca}_3\text{H}_2\text{P}_4$ or apatite is also native. Lime does not precipitate with

Ammonia Sulphate of Lime or Sulphide of Ammonium nor with Chromate of Potassium. White precipitate with Phosphate Carbonate Oxalate.

Aluminum al sy. 6

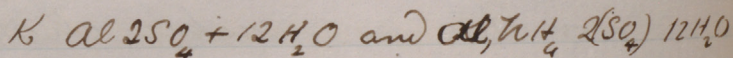
sp. g. 2.5 Discovered by Wohler

It is malleable ductile and sonorous. Oxidizes slowly, Nitric Acid has no action on it

Chloride Al_2Cl_6 soluble in caustic potash.

Oxide Al_2O_3 found combined with silica, is soluble in caustic potash not in Solution Ammoniac

Its sulphate is found combined with Potassium and Ammonium which when refined give the alum of Commerce with the formulas



If its oxide is heated on carbon it turns blue with nitrate of cobalt. White precipitate with Sulphide of Ammonium, also one with caustic Potash soluble in excess.

Magnesium. Mg. 24

found in dolomite as a carbonate also in sea water and various springs as Sulphate etc. It burns with a brilliant white flame and is soluble in acids or Chloride of Ammonium

MgO Oxide soluble in acids with no effervescence

Carbonate ~~soluble~~ $MgCO_3$ $MgO + 5H_2O$ prepared of different densities

$MgSO_4 + 7H_2O$ soluble in 8 parts of water. This is the Epsom salt of commerce. Precipitated with ammonia insoluble in excess.

Magnesia is precipitated with caustic alkalis soluble in excess white precipitate with Carbonate of Soda or Potash if Ammonia is absent.

Zinc 65 Sp. gr. 6.8 to 7.1

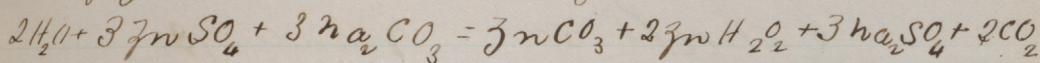
Found in various forms as Calamine Carbonate from Belgium also as Blende as Red Oxide in New Jersey. Zinc volatilizes. It is soluble in solution of caustic potash forming a salt of the formula K_2ZnO_2 . Zinc is used in making German Silver and brass. It is also used as a pigment. It forms a white sulphide.

ZnO Oxide of Zinc formed by burning zinc in air. This is apt to be impure as Arsenic Lead and Cadmium are often associated with zinc. $ZnCl_2$ Its Chloride is a powerful disinfectant it is also poisonous. Carbonate of Soda Emetics and demulcents are good antidotes.

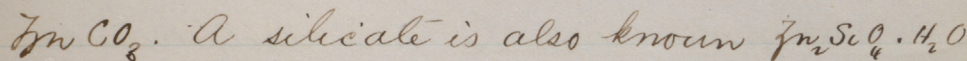
$ZnSO_4 \cdot 7H_2O$ Sulphate of Zinc soluble in $2\frac{1}{2}$ pts water is a powerful emetic; to distinguish it from Epsom dissolve and precipitate with NH_4 the

precipitate is soluble in excess

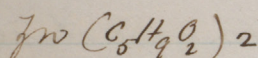
Carbonate $ZnCO_3 + 2ZnH_2O_2$ prepared from Sulphate of Zinc and Carbonate of Soda



Native carbonate or calamine has the formula



Acetate formed by dissolving Carbonate or Oxide in Acetic Acid $ZnC_2H_3O_2$ also the Valerianate



Zinc salts are astringent emetic poisonous.

Zinc in acid combinations white precipitate not precipitated with Sulphuretted Hydrogen gives a white precipitate with Ammonia Sulphide

• • • " with alkalis soluble in excess

" " " " Na_2CO_3 or K_2CO_3 insoluble " "

" " " " $K_4FeC_6H_6$.

Cadmium 112 yellow s.g. discovered by Stromeyer found in Zinc ores as a Sulphide, is soft malleable ductile cracks when bent fused at 242° Its Iodide is made by direct union

and is soluble in water and spirit
precipitates with sulphuretted hydrogen

Cobalt 38 Brande 1783

Found in Germany combined
with Arsenic and sulphur as
glance, nearly infusible hard brittle
and magnetic, freely soluble in HNO_3
Solutions of its Chloride or Nitrate are
blue but turn pink if heated. diluted
forms red crystalline salts. Give no
precipitate with H_2S in acid combi-
nations. Black precipitate with
Sulph-hydrate of Ammonia. Blue
with KHO insoluble in excess. Blue
with solution of Ammonia sol in
excess. Green with $K_4FeC_6N_6$.

Nickel 58 Germany

forms green salts with acid re-
actions
no precipitate with H_2S .

no precipitate

Pale green precipitate with KHO insol in excess. Dirty green with $\text{K}_2\text{FeC}_6\text{H}_6$

Iron. Fe 56.

Found in the blood also associated with Platinum Copper Sulphur etc and as Magnetic Oxide Fe_3O_4 ($\text{FeO}, \text{Fe}_2\text{O}_3$) in Sweden and in America or as Iron sand in the Indies Specular metal or anhydrous Fe_2O_3

Haematite from Lancashire anhyd Fe_2O_3 and also in Cornwall, as brown Haematite in France $2\text{Fe}_2\text{O}_3, 3\text{H}_2\text{O}$

Spathe FeCO_3 Crystalline in Saxony.

Clay Iron Stone impure Carbonate with 33 pc Iron. Black Band in Scotland containing 25 pc Bituminous matter. Iron combines as Ferrous or proto salts as bivalent, and Ferric or per salts trivalent.

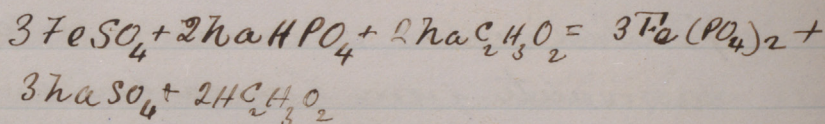
FeO or Ferrous oxide is not easily obtained as it readily oxidizes. Adding caustic

potash to a pure solution of a ferrous salt a hydrate is obtained FeH_2O_2
 Fe_3O_4 Magnetic forms no salts.

FeS or Sulphide used only in preparation of Acid Sulphuric.

$\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ or green vitriol soluble in 3 parts water not in Acids.

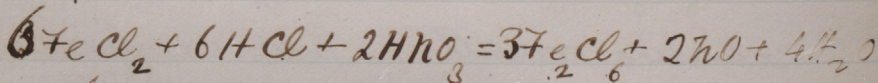
Phosphate $\text{NaHPO}_4 + \text{FeSO}_4 = \text{FeHPO}_4 + \text{NaSO}_4$
 or the new method



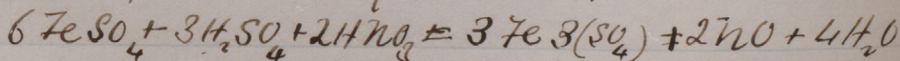
FeCO_3 its carbonate is obtained by mixing Sulphate with an alkaline carbonate.

Ferric Chloride Fe_2Cl_6

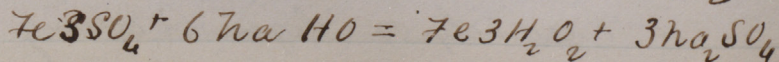
Heat Iron and pass chlorine through it or



Sulphate Monell's Styptic



Hydrated Peroxide $\text{Fe}_3\text{H}_2\text{O}_2$



Ortals formed by combination of the
metal and acid $Fe + 8HNO_3 = Fe_2(NO_3)_6 + 2H_2O + 4H_2O$

Ferrous salts precipitate gray changing to
red by H_2O Ferri cyanide of Potash

$K_4Fe(CN)_6$ blue with Ferrous salts

Sulphuretted Hydrogen changes the red
to the pot as salts sulphur precipitated

Black precip with H_2S . Red with

Sulphocyanide of Potash. Blue with $K_4Fe(CN)_6$

Ergot.

This peculiar growth has been observed in many parts of the world, through the continent of ~~Spain~~ Europe from Spain to South Russia, far up into Norway, and in the high valleys of Switzerland. The fungus has been found in England and in ~~East~~ Eastern Africa; I do not know if it is indigenous in America ^{having met} no note on the subject (in collecting information for this paper.)^{xx} Probably no article in the Pharmacopoeia has been so much or so variously commented on as our subject; what it is? how produced? its therapeutic value & constituents, all have been in turn bases upon which theories plausible ingenious & widely divergent have been built, and no sooner built than criticized and called in question & newer ones brought forward in their place.

xx This continent being favorable to the growth
of all cereals, ~~oat~~ is probably met with,
though not collected.

This constant investigation has proved so beneficial, that Ergot, its production & usefulness are well understood, and it holds in consequence a firm place in our list of reliable medicines.

Its Pharmacopoeial definition is rather startling & requires some acquaintance with a botanical dictionary to understand especially as the revisors of the 1885 edition have pruned away the explanatory clause in the older ~~old~~ works referring to the sclerotium. You can all call it to mind. "The sclerotium of the *Claviceps Purpurea Tulane*, produced between the palea, and replacing the grain of the *Secale cereale*". I would first call your attention to the name *Tulane* to that careful investigator, we owe much of our knowledge of this singular growth his "*Memoire sur l'Ergot des Pharmaciens*" having established the fact that ergot as we have it, is the second or *intermediat*

stage of a biennial fungus.

In an ear of ~~ergo~~ ripe only a few grains are usually attacked, sometimes over twenty, if not. The remaining grains are not affected and when the diseased ones are removed can safely be used as food. Should a large number be ergotised the whole ear often decays rot. It has been ~~been~~ noticed that ergot matures better on isolated rye stalks growing among other cereals. A moist season followed by heat is claimed to be beneficial to ~~the~~ ^{its} propagation. In a note to the 6th edition W.S.D. it is mentioned that two seasons observations made by Mr Price Wetherall showed that ~~Dark Rye~~ sowed very late ^{in the year} was largely ergotised while similar crops in the same locality, put in earlier escaped.

A fungus called honey dew is the first sign of the parasitic growth

'Flukiger + Hambury are followed in this description

after a few days this disappears, leaving
 the grain disintegrated & devoid of starch.
 The ingested ovaries are covered with and pene-
 trated by a white spongy tissue the mycelium
 of the fungus. It is made up of thread like cells
 the outer layer radially divergent. The mycel-
 ium forms by its folds & crevices a number
 of cavities opening outwards. From its outer
 layer the spermatophorum an immense number
 of agglutinated granules, conidia, are
 separated. The honey dew also contains conidia
 in abundance but dilution is needful to
 precipitate and separate it. The mycelium
 penetrates the & envelops the caryopsis with
 the exception of the apex preventing further
 growth destroying the epicarp and embryo.
 At the base of the caryopsis is formed by time
 fusion and the gradual transverse separation
 of the thread cells a compact kernel like body
 gradually increasing in size, & separating
 from the mycelium as the latter its
 work done dies up & shrivels. The reman-

of the mycelium, and conyoposis and occasionally of a complete grain if ~~it~~ one has formed before the fungus attaches itself are met with crowning the apex of the unattached ergots. With the next stage we have little to do, but the further growth presents interesting features.

Falling to the ground, the skin after a time, folds back here & there and small heads push out, in a week or two reaching an inch in length. On the surface of the heads are the cavities containing numerous spores, each sack ~~xxx~~ having eight spores. The spores are discharged united in silky white flocks, and in vast numbers, not less than a million being credited to a single ergot. Having followed the development of the fungus, we may turn for a time to the many theories ^{as about its growth} in turn admitted and ~~not~~ rejected. DeCandolle in 1816 thought that ~~mycelium of~~ ergot was a complete fungus and named it *Sclerotium Clavus*, ^{his follow-} ~~ad~~

this idea changing the name to *Spermogonia* *clarus*. Leveille in 1827 also supported this view. Hackett who called it *Erautocha abortifaciens* claimed that the growth began with the mycelium spreading over the grain; and that the sponidia (conidia) were its reproductive agents, a fact partly true as Kuhn in 1863 proved that the mycelium could be grown from the conidia. Hackett claimed that Ergot is partly fungus & partly diseased grain, his reason being the frequent remains of grain the stigma and occasionally of the grain on the apex of the ergot. The U.S. Dispensatory of 1846 supports this view. Against it stands as evidence the fact that neither externally or internally does ergot bear any resemblance to a ripe grain; proof being convincing that the grain is done away with not converted. The theory of insect production was advanced by Rees; and in a work published in 1832 the author says "Rees is without

advanced the idea that the mycelium was a complete fungus in itself.

doubt right. I have frequently observed the insects (*Aphis Graminis*) at work. Even as late as 1843 in Hooker's Dictionary the same view is adopted. The frequent appearance of insects round the honey dew and especially of a red beetle "*Bhagomycha Melanura*" gave some ground for this fallacy. Schuman ^{in 1807} appears to have noticed the third stage of the fungus, and considered it a separate plant naming it *Sphaeria*. Adam Lonicer of Frankfort in the 16th century describes ergot in the rye fields and remarks that women find it of certain & great efficacy in obstetrical cases. Johannes Thalus also makes mention ^{of it}, In the 17th century Caspar Bauhin names it *Secale Luxurians* and later again Ray the botanist treats of it. Rathlaw first used it in 1747 and thirty years later Desgranges of Lyons gave it some prominence. So Dr Stearns of Saratoga Co; N.Y. belongs its real introduction in

1807 to the medical profession. It appears in the first U.S.P. 1840 under the heading of *Secale Cornutum* Spurred Rye called Ergot. Again in the 1830 edition it is described as a parasitic fungus of the *Secale Cereale*, and the dose is placed at 10 grs. The London Pharmacopoeia adopted it in 1836 as a derivative of the *Accumula*, Charles of Fries, who it may be said had no such fungus mentioned in any of his writings. About the same date it was adopted by the Edin. Ph. as an undetermined fungus with degenerated seed of the *Secale Cereale*. The U.S.P. 1840 changed its official designation to Ergot in conformity with the British authorities, and placed a wine of ergot among the official preparations, to replace the various tinctures used in the country.

In the U.S.P 1864 Ergot retains its old name, though its designation becomes "the diseased seed of the Secale Cereale".

The first B.P 1864 has the definition 'practically, as our present authority, & its ^{to} three of the preparations ^{are still} now in unchanged as to strength. The B.P 1867 has the definition nearly as the present authority and the U.S. P of 1880 ¹⁸⁷⁰ are very similar.

The constituents of Ergot have been the field of much research and great difference of opinions has resulted from the ~~research~~ investigation. Buchheim considers that ^{Ergot} owing to its low organization does not form well defined crystalline principles. Wiggert in 1830 obtained an alkaloid he called ergotin, & Wenzell in 1864 obtained two Ergotin + Echoline, combined with Ergotic Acid. Junnet isolated Ergotinine a crystallized alkaloid 1877. Dragenb. & his pupils furnish the following list of amorphous principles. Sclerotin and

1 as the grain diseased by an imperfect fungus.

Scleromucin, mucilaginous in its nature
 Sclererythrin a red colouring, Sclerogodin
 fusco-sclerotinic Acid; Picrasclerotine
 Scleroxanthin & Sclerocrystallin. We
 cannot in this paper enter further into
 its composition, that subject alone would
 require a treatise to itself.

The peculiar effects of this drug on the
 uterus have long been known. As mentioned
 before it was employed by German midwives
 two centuries ago, its common German name
 mutter or womb corn being derived from
 its use. A writer early in the century
 states that it is used in America to
 produce abortion. Its efficacy in arrest-
 ing childbirth has been disputed by
 many writers; one a German going so
 far as to say that it has no connection
 with the uterus except through the name
 mutter common to both, but testimony
 in its favor far outweighs any inimical
 to its reputation. Ergot has been employ-
 -ed

in checking haemorrhages through its action
 on the muscular coats of the bleeding arteries
 for the expulsion of coagula of blood, polypi
 or hydatids from the uterus. Success is claim-
 ed for it in paralysis of the bladder. Erithe-
 haemorrhoids and some skin diseases, as a
 poison Ergot has had a wide field for mis-
 chief, and it has ~~done~~ ^{caused} much illness and
 death. Its operation is chiefly on the nervous
 & circulatory functions and it seems to act
 in two distinct ways, one sometimes called
 convulsive ergotism manifesting itself
 in giddiness, insensibility, convulsions &
 rapid death, the other gangrenous, in
 weariness pains and fever, with formation
 of dry gangrene on the limbs & joints the
 parts attacked blackening & drying &
 falling off. These last symptoms are also
 noticeable in animals affected by ergot.
 The gangrenous complaint generally arises
 from the use of ergotised flour and ~~has~~ ^{was}
~~been~~ known for many years under such

names as, "Morbus Spasmodicus," epidemicus
vel cerealis, "Raphania," "Ignis Sancti Antonii"

The epidemics in Europe during the 6th and
8th centuries are attributed to ergotism, &
evidence points to our subject as the cause
of the plagues in France in the 10th and
in Spain in the 12th centuries. There suffered
severely in 1576 from a pestilence which the
Warburg Med. Faculty considered ergot to
blame for. Further epidemics are reported
in Germany in 1648, 49, 75; 1702-16-17-22
36 & 41; in France in 1630 & 1816. More recently
cases have been met with in Bavaria &
Abyssinia. In Germany poisoning is said
to take place by contact such as sleeping
on attacked grain, and a case is recorded
of when ergot carried in the pocket gave
rise to unpleasant symptoms which passed
till the pocket was well washed.

Ergot has several officinal^{al} preparations
in both the U.S. & B.P., The oldest being
the one introduced into the 1840 Ed.

3rd

the U.S.P. with a strength of 23 to the ounce ^{sherry} in 1850 this was reduced to half its strength, restored at the next revision; changed in 1870 to 4 fl oz extract to 28 fl oz Sherry and in the last edition changed again to powder and strengthened to about 4 fl two & a half oz to the pint; to draw 1 to 2 fl draws remaining unaltered. The preparation is not much employed and I do not remember a call for it in twelve years experience.

The fluid extract is decided by the leading preparation of ergot. In the U.S.P. of 1860 it was ordered to be made with Dilute Alcohol & Acid Acetic, and in 1870 33 Glycerine to the pint were added. The acetic acid was ordered to prevent volatilization of the tryptamine but its addition is of doubtful value. The Glycerine was rather useless than otherwise as it prevented concentration if necessary for hypodermic or other use. The presence of Acid Muratic

Trimethylamine is yielded if ergot or its alcoholic extract, is treated with an alkali and is a product of the decomposition of albuminoid bodies, some writers have endeavored to prove its existence in ergot as a phosphate but Sangell ascertained that no such base pre-exists.

in the new official ^{extract} edition of the U.S.P. is said by Little & Woisch to be valuable, the alkaloids of ergot being now volatile while trymethylocarni is a product of decomposition and does not probably contribute to the activity of the medicine. The D.P. preparation was ~~to~~ obtained by first extracting the fixed oil with ether and then, percolation with water, condensation and sufficient spirit added to preserve it; but the 1885 edition has a much simpler process, viz extraction by water + preservation by spirit. The absence of mineral acids + its easy concentration render this. The dose varies; in uterine inert a $\frac{1}{2}$ fl dr repeated at short intervals is recommended but as high as 8 drams has been used in other complaints.

The infusion ~~does not~~ only appears in the B.P. + has remained unchanged since its introduction in the original edition.

$\frac{1}{4}$ oz to 10 fl oz ^{boiling} water. Tincture Ergot is also a B.P. preparation, 5% to the pint.

probably the most useful formula yet presented.

The authorities in this case have ordered the ergot to be more finely divided in each revision starting with bruised, then in coarse powder, ~~and finally~~ ^{and finally} ending in fine powder the object being a more thorough exhaustion of the active ingredients.

Ergotin was added to the BP 1880 to ~~rep~~ give an official preparation for Bonjean Ergotini. The fl extract is taken, evaporated down and after mixing with spirit, further evaporated to a suitable consistency, a ~~suppo~~ desmic solution made by dissolving 1 pt of this in two camphor water is also in the new edition.

An extract of ergot is also in the USP 1880 prepared from the fl extract 5 grs being reduced to one by evaporation, its dose is given from 3 to 15 grains.

The liability of ergot to spoil renders it necessary to be very careful with its ~~prep~~ preservation. Some authors claim that after a year its activity is impaired.

P. ul. parturient

but the chief danger comes from a small mite
 a species of *Trombidium* which eats the interior
 leaving only the thin external shell. The powder
 is also liable to attacks from insects, and
 to lose its usefulness from the rancidity
 of the fixed oil contained. Camphor is a
 good safeguard from the insects and the
 rancidity may be avoided by providing
 only as required.

The supplies of ergot are drawn from Teneriffe,
 Cayo, Hankow, France, Russia; the amount
 yearly imported to this continent is between
 900,000 pounds, having increased ^{from 1850} ~~to~~
^{pounds} ~~in~~ ^{the} twenty years ago. Its price has greatly
 decreased since its first introduction, the
 price in London 60 years ago being 50s per
 lb.

Before closing this paper reference must be
 made to ergot in other plants, & it gives
 a list of fourteen ^{genera of} grasses certainly attacked
 - mention one or two more as doubtful.

Ergot of Wheat is claimed by Carbonneaux

Le Perdriel to be less prone to deterioration & to be free from the poisonous qualities of rye ergot. Prof Reilly has found that wheat ergot kept its qualities unimpaired for ten years during which time a sample of the official, under the same circumstances, was totally destroyed. Wheat ergot is shorter & heavier than rye, rarely more than one in an ear & that generally in very damp weather. In Italy it is picked by hand from grain used in ^{the} vermicelli manufacture.

Ergot of Oats, as found is much more slender than the rye ones, it is generally sold mixed, with though occasionally a sample free from rye is met.

Ergot of Dips. a north african grass is from 1 to 3 inches long by $\frac{1}{10}$ in broad, curved or twisted spirally, according to Lallemand its activity is double that of rye. Some Ergot lately used to some extent is not an ergot at all, but a complete fungus of the order Ustilaginine.

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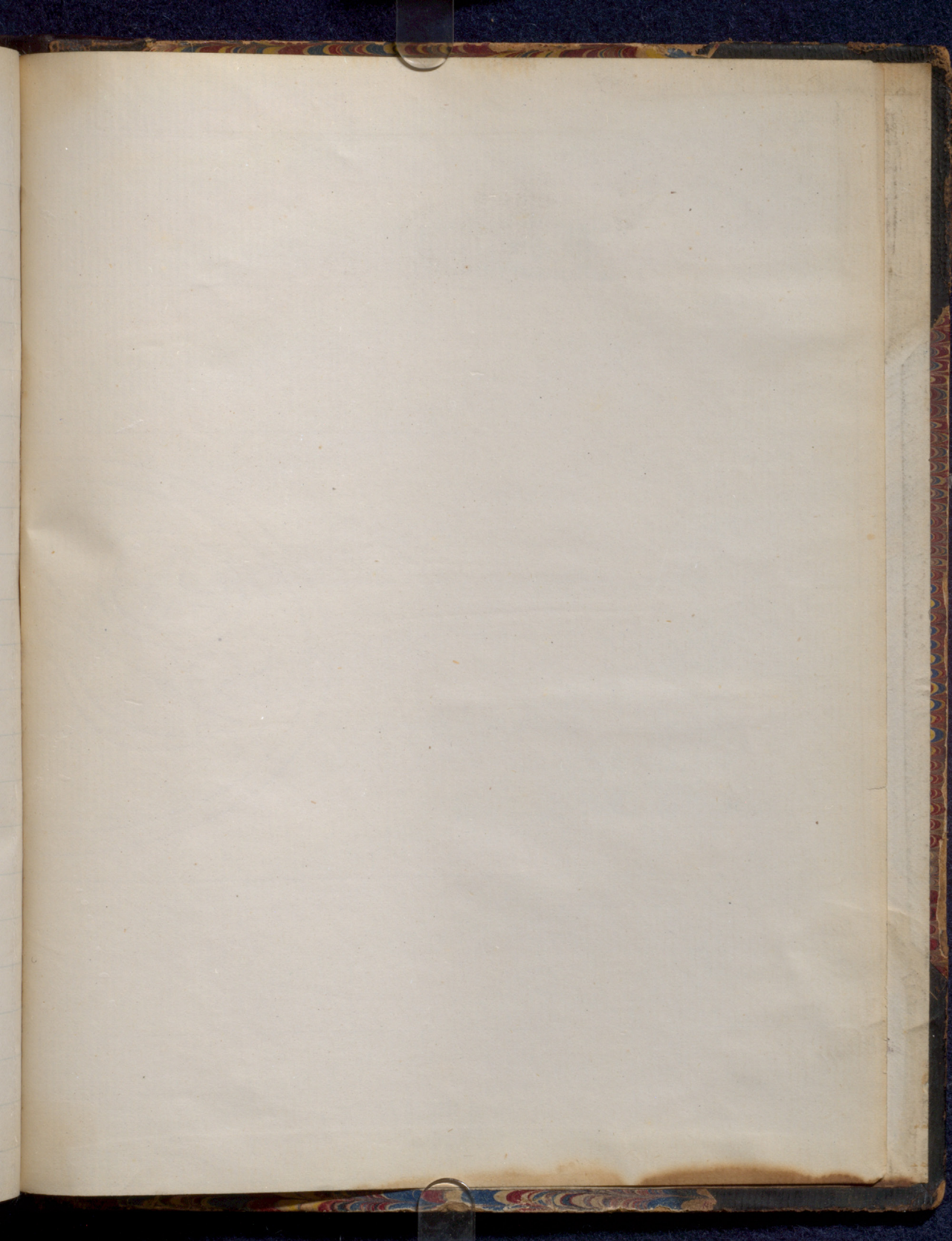
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1/
PYCL

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Red

Yellow

Green

